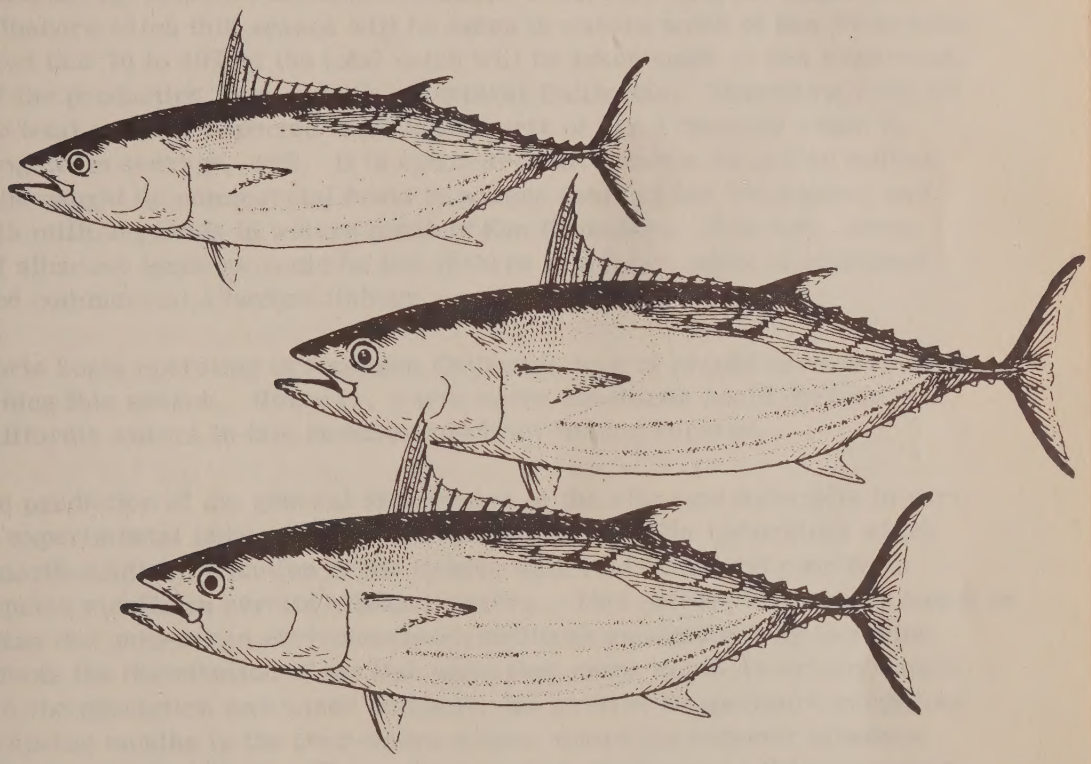
MAY 1972, No. 5

FISHING INFORMATION

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



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ALBACORE TUNA FORECAST FOR 1972

This is the 12th annual advisory to be issued by the National Marine Fisheries Service (NMFS) - formerly Bureau of Commercial Fisheries - for the albacore tuna fishery off the North American Pacific coast.

Based on 1) environmental conditions, and 2) the trend in the historical record of commercial albacore catch distribution, it appears that the major portion of the albacore catch this season will be taken in waters south of San Francisco. It is estimated that 70 to 80% of the total catch will be taken south of San Francisco, with most of the production from waters off central California. Therefore, only 20 to 30% of the total catch is expected to be taken north of San Francisco which is below the long-term average, 36%. It is estimated that between 30 and 45 million pounds will be caught by commercial boats in waters south of San Francisco, and from 10 to 15 million pounds in waters north of San Francisco. However, these estimates of albacore landings could be low if there is a large influx of additional boats into the commercial albacore fishery.

Sports boats operating in southern California waters should have very good albacore fishing this season. However, warm water conditions could develop in southern California waters in late summer and limit fishing success.

The prediction of the general distribution of the albacore fishery is in part based on an experimental index developed at the NMFS La Jolla Laboratory which relates the north-south distribution of the fishery with environmental conditions during the spring months in certain offshore waters. This method is partially based on the assumption that mid-ocean environmental conditions encountered by incoming migrants affects the distribution of the fish when they enter North American waters. In past years the prediction was based solely on sea surface temperature conditions observed in spring months in the near-shore waters where the summer albacore fishery traditionally takes place. The earlier method was based on the assumption that trends in environmental conditions observed in spring months persist and indicate the probable distribution of sea surface temperature in mid-summer. However, experience has shown that dynamic air-sea interaction processes during the summer can considerably alter temperature conditions observed during the spring period prior to the fishing season.

The estimates of tonnages that are expected to be landed during the 1972 albacore fishing season are based on statistical calculations with historical data. Current population dynamics research underway at the NMFS La Jolla Laboratory and elsewhere should enable us in the near future to make more accurate forecasts of tonnage and general size of the fish that will enter the fishery.

AVERAGE SEA SURFACE TEMPERATURE

The 12-year average (1960-1971) of optimum temperature zone for albacore for the July 1-15 period is shown in the shaded portion of Plate 1. The majority of the albacore caught in North American waters are taken in waters of this temperature range. Prevailing weather during this period in 1972 will likely cause deviations from this average pattern which will influence the distribution of albacore. We will monitor the evolving temperature patterns in order to project the albacore distribution as the season develops.

RECENT TRENDS IN OCEANIC AND ATMOSPHERIC CONDITIONS

During the last 2 weeks of May, sea surface temperatures along the North American coast were slightly below the long-term mean from northern Washington to Point Conception and out to 130° W. Colder temperatures about 2° F below the long-term mean occurred offshore Vancouver Island and in localized coastal areas off Cape Blanco and between Point Arena and Monterey. Sea surface temperatures were slightly above the long-term mean south of Point Conception to central Baja California and out to 125° W, except for a region along the coast and south of Ensenada where temperatures were below the long-term mean. The 60° F isotherm was near its normal position except between about 125° and 130° W where it was displaced to the south (Plate 2).

During the winter of 1971-1972, thermal conditions in the eastern North Pacific were characterized by a "warm pool" of above-normal temperatures over a large central region between latitudes 25° N and 50° N and to the west of longitude 140° W, while below-normal temperatures prevailed in a broad zone extending southward from the Gulf of Alaska along the North American coast and westward towards Hawaii south of 25° N. These conditions resulted in a strong east-to-west thermal gradient and were indicative of increased flow in the California Current system.

In March 1972, this strong thermal contrast began to dissipate, with the "warm pool" shifting eastward and southward. It diminished further during April 1972 as warm temperatures in the central oceanic regions and cool temperatures along the coast edged closer to normal values. By the end of May 1972, remnants of the above- and below-normal temperature regions were present but greatly reduced in size and intensity from what they were during the previous winter.

The evolution of these changes in the large-scale thermal conditions of the eastern North Pacific can be linked to abnormal circulation patterns in the overlying atmosphere throughout the winter of 1971-1972 and spring of 1972. During the late

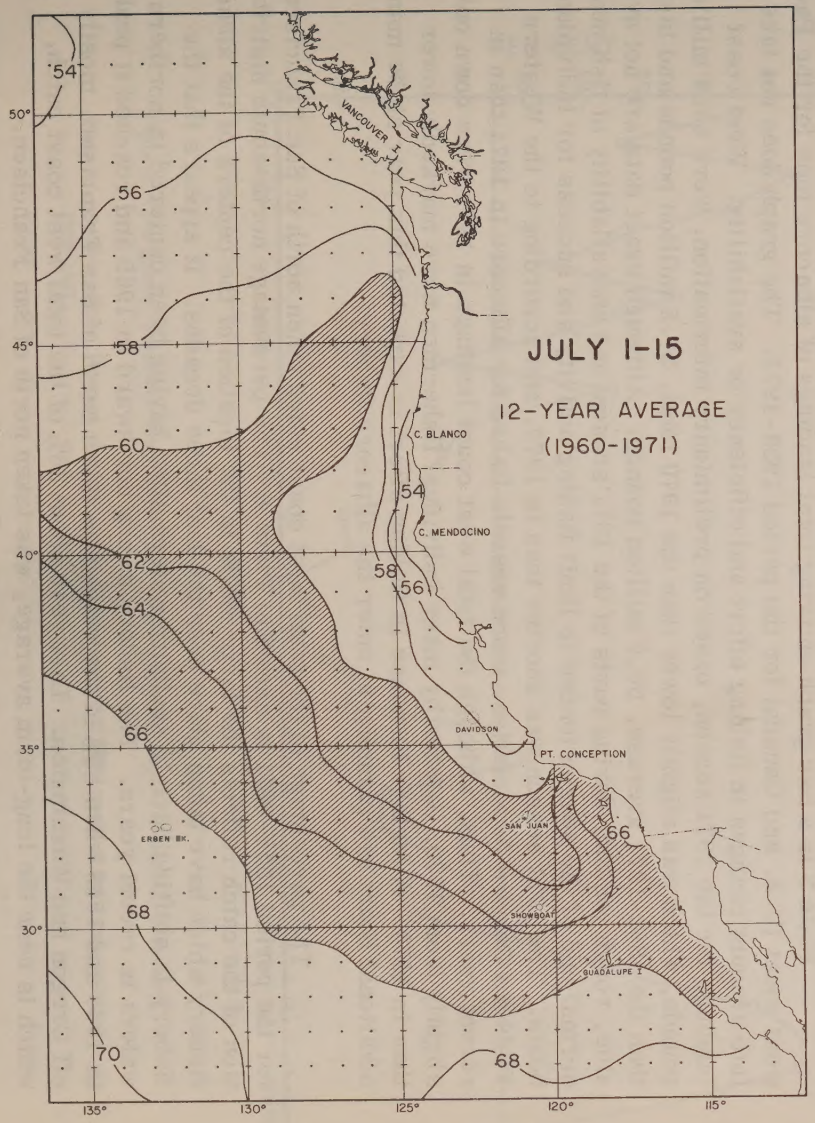


Plate 1.--Average sea surface temperature fields for the July 1-15 interval. Shaded zone delineates region where most of the albacore would be available under these conditions.

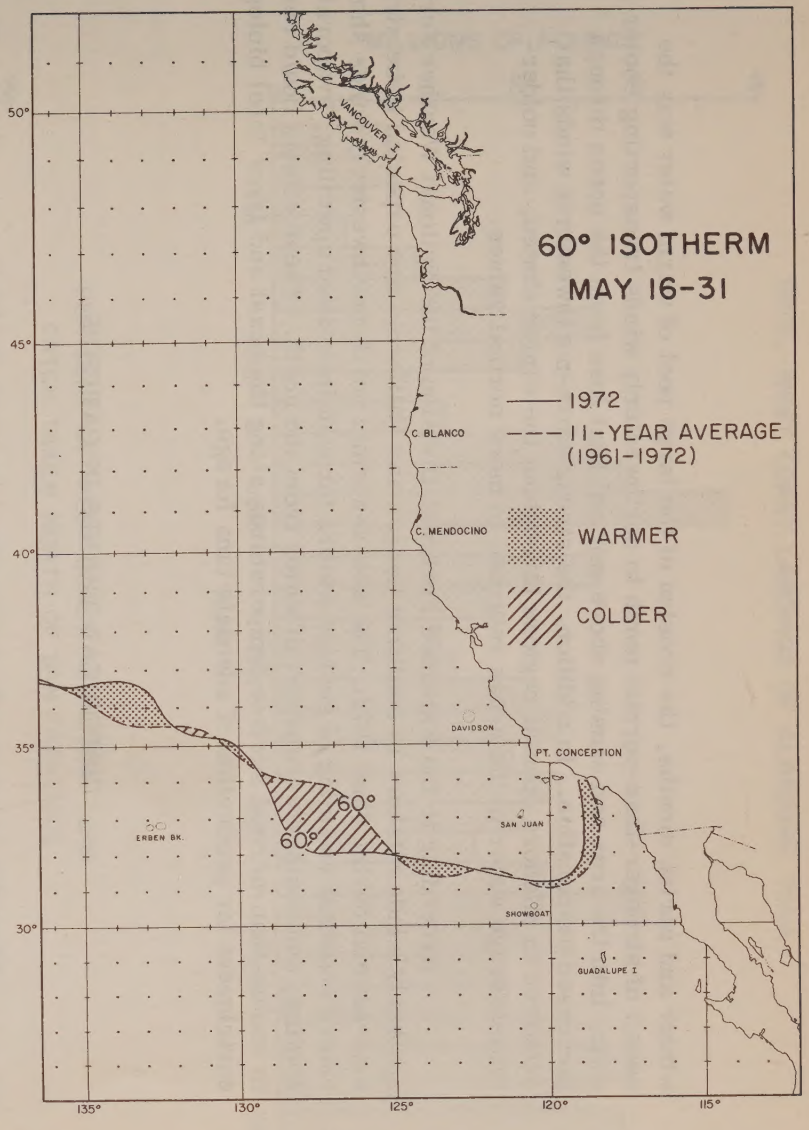


Plate 2.--Relation of position of May 16-31, 1972, 60°F. limiting isotherm to long-term average position for the same interval.

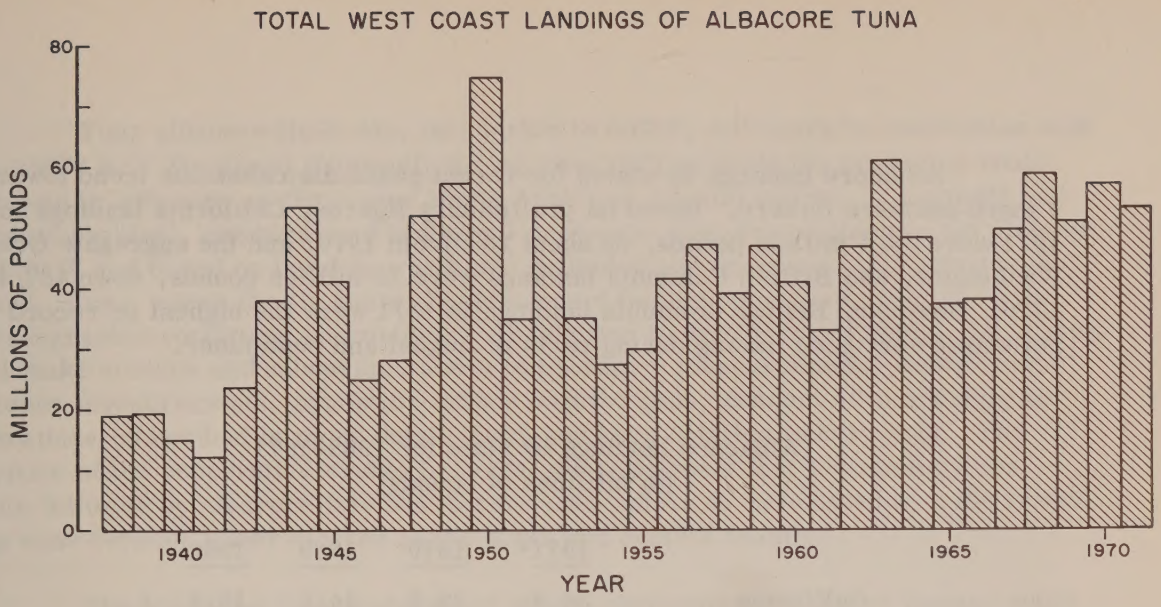
winter and spring months, the erosion of the large pool of warm water was the result of stronger-than-normal north to northwesterly winds transporting cooler water into the area and causing above-normal heat loss from the ocean through increased evaporation. In addition, the strong north-northwesterly winds that occurred in offshore coastal regions throughout the winter abated, and colder-than-average water in the areas returned to more normal values.

According to the Extended Forecast Division of the National Weather Service, northerly winds offshore of southern Oregon and California are expected to be stronger-than-normal during June 1972. The above-normal north-northwesterly winds should retard seasonal warming of surface waters through increased upwelling, evaporative cooling, and southerly transport of water from the north. These effects could result in cooler-than-normal surface temperatures along the coast and favor local biological enrichment for production of adequate tuna forage.

HISTORICAL TRENDS IN CATCHES

Plate 3 is a bar graph showing total landings of albacore tuna for the Pacific west coast (U.S. and Canada) for the period 1938-1971. The graph does not take into account changes in fishing effort and efficiency or availability. West coast landings for the 1971 season, based on preliminary information, were 53.4 million pounds, which was slightly lower than the 1970 total, 57.5 million pounds and higher than the 1962-1971 average, 50.0 million pounds. Although exact data are not available, rough weather during parts of the 1971 season and unavailability of fish near the normal end of the season tended to limit fishing activity and success for individual boats. The 1971 season was shorter than in 1970, and according to the Western Fishboat Owners Association, more vessels fished for albacore in 1971 than in recent years. Thus, although the total west coast landings in 1971 were down only slightly from 1970, catches by many individual fishermen were markedly lower than in 1970. A further increase in fishing effort is expected this year since many additional boats are planning to enter the albacore fishery.

The percentage of the total west coast catch taken north of San Francisco for the period 1938-1971 is shown in Plate 4. The percentage north-south distribution of the catch reflects the large shifts in the location of the centers of the albacore fishery which have taken place over the last three decades. It appears that the fishery is shifting back to southern waters after having been centered in northern waters in recent years. The fishery swung northward in 1965 and reached it peak in 1968 and 1969 when 85% of the catch was taken north of San Francisco, mostly off Oregon and Washington. Last year about 36% of the total west coast catch, which is near the long-term average, was taken north of San Francisco.



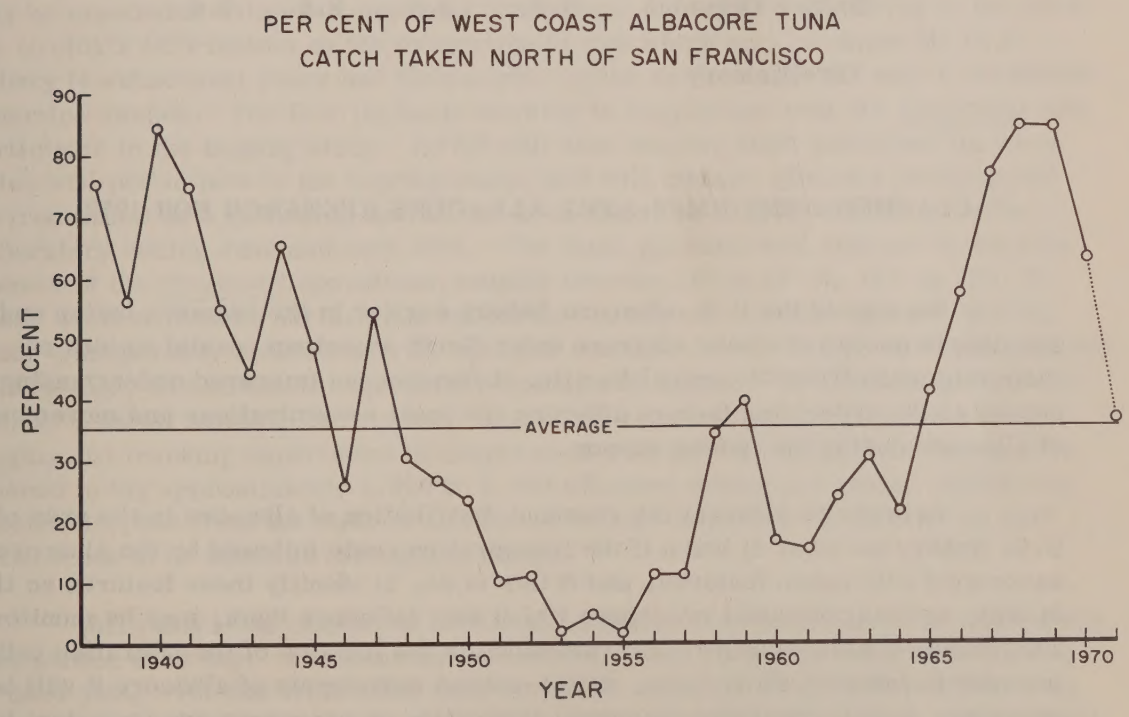


Plate 3. --Top graph: Total west coast landings of albacore tuna in millions of pounds, 1938-1971.

Plate 4. --Bottom graph: Percent of west coast albacore tuna catch taken north of San Francisco, 1938-1971.

Albacore landings by states for recent years also show the trend towards a more southern fishery. Based on preliminary figures, California landings for 1971 were 38.4 million pounds, up about 28% from 1970, and the aggregate Oregon, Washington, and British Columbia landings were 15 million pounds, down 46% from 1970. However, British Columbia landings in 1971 were the highest on record reflecting very good fishing during parts of August and September.

Albacore landings by state for 1968-1971
(in millions of pounds)

	1971*	1970	1969	1968
California	38.4	29.9	14.7	15.1
Oregon	8.4	21.8	29.8	37.8
Washington	2.9	4.3	3.5	3.0
British Columbia	3.7	1.6	2.5	2.6

*Preliminary

PLANNED JOINT NMFS-AFRF ALBACORE RESEARCH FOR 1972

To expand the U.S. albacore fishery earlier in the season a better understanding is needed of where albacore enter North American coastal waters on their migration from the central Pacific. Likewise, an improved understanding is needed of the underlying factors affecting the local concentrations and movements of albacore during the fishing season.

In order to forecast the seasonal distribution of albacore in the area of the U.S. fishery we must 1) learn if the immigration route followed by the albacore is associated with ocean features, and if this is so, 2) identify these features so that 3) they, or environmental processes which may influence them, may be monitored. This should enable us to forecast variations in the location of the migration pattern. In order to forecast short-term, within-season movements of albacore it will be necessary 1) to learn if environmental properties or processes are important in influencing albacore movements, 2) if so, monitor and/or predict key environmental indicators, and 3) make use of this information to anticipate movements of albacore.

The National Marine Fisheries Service La Jolla Laboratory and the American Fishermens Research Foundation plan cooperative albacore research studies during the 1972 season to obtain information on large-scale and small-scale migratory patterns of albacore.

Four albacore jig-boats, on charter to AFRF, will work in conjunction with the NMFS R/V Townsend Cromwell during June 1972 to study the migration route followed by albacore as they enter North American coastal waters. Cromwell will conduct physical, chemical and biological oceanographic observations in the vicinity of 140° W and based on the data which are collected and processed immediately on board, direct where the jig boats should conduct fishing operations relative to the oceanographic conditions encountered. In addition to exploratory fishing, the vessels will make surface and subsurface ocean temperature measurements, water transparency measurements, synoptic weather observations, conduct albacore tagging operations (described in more detail later) and keep detailed fishery logs. The purpose of the cooperative cruise is to test the hypothesis that the immigration route followed by albacore into North American waters is associated with the transition zone between water masses in the north and central Pacific.

The NMFS La Jolla Laboratory is also directing an albacore tagging study which is designed primarily to examine movements of albacore within North American coastal waters during the U.S. fishing season and determine if movements may be associated with environmental conditions. Secondary objectives of the study are to obtain information on the proportion of fish which may re-enter the U.S. fishery in subsequent years and obtain information on mortality for use in population dynamics studies. The four jig boats working in conjunction with the Cromwell will participate in the tagging study. AFRF will also charter eight additional jig boats which will participate in the tagging study, and will conduct albacore scouting and environmental data gathering operations in cooperation with the NMFS La Jolla Laboratory during June and July 1972. The eight jig boats will operate in the area inshore of the Cromwell operations, roughly between 30° to 47° N, 127° to 135° W. These boats will make surface and subsurface ocean temperature measurements, water transparency measurements, synoptic weather observations, and keep detailed fishery logs, in addition to exploratory fishing and tagging. In addition, AFRF will charter a small bait boat during July-August for conventional tagging and a sonic tagging and tracking experiment in cooperation with the La Jolla Laboratory. It is planned to tag approximately 4,000 to 5,000 albacore during the study. NMFS was granted $10,000 from the State of California Marine Research Committee as part of the funds to be used for the tagging study.

All vessels on charter to AFRF will radio ashore environmental and fishery information each day. The information received from the cooperating vessels will be used along with that from other sources in the albacore tuna fishery forecasting operations at the NMFS La Jolla Laboratory. The BATHY and weather observations will be passed to the Navy Fleet Numerical Weather Central and weather observations to the National Weather Service.

AFRF will supply single side-band radio communication equipment, portable live-bait holding tanks, certain fishing equipment, and wind gauges to each of the boats on charter. NMFS will provide scientific advice, fish tagging equipment, and

scientific equipment including expendable bathythermographs (XBT) and XBT probes (latter supplied by Navy Fleet Numerical Weather Central, Monterey, California), thermograph (one boat), bucket thermometers, secchi disks, and radio facsimile recording equipment. NMFS is also providing seven technicians to do tagging aboard the fishing vessels on charter to AFRF.

The operations of the vessels on charter to AFRF are being coordinated with the Fish Commission of Oregon early season albacore exploratory cruise and the albacore-oceanography cruises to be conducted by Oregon State University.

The NMFS La Jolla Laboratory plans to conduct an albacore sonic tagging experiment in August 1972: 1) to study the small-scale movements of schools of albacore in relation to environmental conditions and 2) to evaluate the feasibility of fishermen using sonic tags to locate a school(s) of albacore which were fished the previous day, but lost during the nighttime, shutdown period. The scientific objective of the study is to improve our understanding of the underlying factors affecting the prediction of local concentrations and movements of albacore during the fishing season. Results of the experiment should provide considerable information concerning movements of albacore schools such as 1) diel patterns of movement, 2) rates of movement, 3) how much time a school spends at the surface, and 4) environmental factors which may influence movements. All of these results have practical value to the fishermen in locating and catching albacore more efficiently and scientific value to NMFS scientists engaged in fishery-forecasting research. NMFS fishery scientists will work from the bait boat on charter to AFRF during the second half of August to conduct the sonic tagging and tracking operations. The NMFS R/V David Starr Jordan will be conducting albacore-oceanography research during August, and will coordinate her work with that needed for the sonic tagging experiments. Jordan will make a suite of environmental observations including subsurface temperature, salinity, and other hydrographic measurements, and do continuous monitoring of surface temperature, salinity, and chlorophyll. Numerous observations will also be made to evaluate biological factors of the environment including primary productivity, zooplankton standing stock, and measurements of the small-scale distribution and relative abundance of potential albacore forage organisms using a specially developed sampler. In addition, it is planned to use a light aircraft equipped with an airborne radiation thermometer to make overflights to obtain a synoptic evaluation of the small-scale features and changes in the distribution of sea surface temperature in the area where the sonic tagging is conducted. The McDonnell-Douglas Astronautics Company is also participating in the experiment making overflights with an aircraft equipped with a multi-spectral scanner for measurement of ocean color and other data. The environmental data gathered by Jordan and the aircrafts will be used to determine if environmental conditions influence or control small-scale movements of albacore, as indicated by sonic tracking.

NMFS ADVISORY OPERATIONS FOR THE 1972 SEASON

The La Jolla Laboratory of the National Marine Fisheries Service will issue albacore advisory information throughout the 1972 season in addition to the above forecast. The advisory information will include sea surface temperature charts, narrative albacore fish bulletins, and daily broadcasts of albacore fishing information over marine radio bands.

The albacore fish bulletins will be issued twice each month from June 15 until the season ends, in conjunction with 15-day sea surface temperature charts. The 15-day sea surface temperature charts, which are now issued year round, cover the area roughly between central Baja California and Vancouver Island out to 135° W. The bulletins will include short-term projections of albacore distribution and locations of productive fishing areas, information on oceanographic and atmospheric conditions, and other information as is appropriate.

This publication, Fishing Information, appears monthly and contains 1) charts of sea surface temperature for the North Pacific and eastern tropical Pacific, 2) sections of subsurface temperature structure for parts of the North Pacific, 3) charts of winds and pressures for the eastern North Pacific, 4) a narrative description of pertinent temperature conditions, and 5) fishery advisory information. All the NMFS fishery advisory materials are mailed to fishermen upon request and are bulk-mailed to fish buyers and processors for further dissemination to fishermen.

Daily broadcasts of albacore fishing information will also be prepared by the La Jolla Laboratory and will be transmitted over marine radio bands again this year. The broadcasts will be made twice daily on weekdays and once on Saturday mornings from June 12 through October 31, or until the albacore season ends. The broadcasts will include the latest albacore fishing information obtained from research vessels, cooperating fishing vessels, and unloading station operators. Highlights will include location of active centers of fishing, typical fishing scores, size of fish, sea surface temperature and subsurface temperature information when available, and other information as appropriate. Sport boat activity will also be included. A weather and sea state summary tailored for fishermen's needs will also be given including large-scale weather features and long-range outlook, regional wind, weather, and sea state conditions outside 40 miles, and storm development. In addition, each 15-days the broadcast includes map coordinates for the 15-day average position of the 60° and 64° F isotherms for the region east of 130° W longitude and between 25° N and 50° N latitude.

Nearly coast-wide reception of the albacore fishery advisory broadcasts will be available this year as the result of the excellent cooperation of the Pacific Northwest Bell Telephone and Telegraph Company and radio station KRED in Eureka, California. In addition to being transmitted by radio station WWD, which

is licensed to the NMFS and located on the Scripps Institution of Oceanography (SIO) campus at La Jolla, California, the broadcasts will be made by radio station KRED in Eureka and the Astoria Marine Operator, KFX.

WWD will broadcast on AM compatable voice frequency 4409.4 kHz and on single side-band on carrier frequencies 4409.4, 8789.6, 8644.1, and 13147.5 kHz at 0600 and 1945 PDT. KRED will broadcast on commercial AM frequency 1480 at 0600 and 1945 and Astoria Marine Operator, KFX will broadcast on frequency 2598 kHz at 0600 and 1945 PDT.

The success of the albacore advisory program depends on the input of timely, first-hand information from fishermen at sea, as well as from dock operators and processors. Fishermen are encouraged to report oceanographic, weather, and fishing information. As a channel of communication for such information radio station WWD will operate the following voice single side-band frequencies and schedules:

Carrier frequencies	
WWD transmit	WWD receive
4409.4	4410.8
8789.6	8255.6
13147.5	12368.5

Hours of operation are 0400-0100 local time, 7 days per week, including holidays. Information may also be radioed to the Western Fishboat Owners Association, and the NMFS La Jolla Laboratory will accept collect calls from fishermen at sea to report oceanographic, weather, and fishing information.

For further details concerning the National Marine Fisheries Service Albacore Information, please contact:

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VERTICAL SECTIONS OF SUBSURFACE TEMPERATURE IN THE NORTHEAST PACIFIC OCEAN

Subsurface temperature sections between San Francisco and Honolulu at the beginning of the month (April 30-May 3, 1972) and at mid-month (May 13-17, 1972) are shown in Plates 5 and 6 respectively. The format of the plates has been altered to include a station location chart and the XBT profiles at four selected stations. We shall generally select one station near the California coast which is typical of the California Current waters and one relatively near Hawaii which is typical of Eastern North Pacific Central Waters. The other two profiles will generally be selected to show certain conditions in or near the transition zone between the two regions.

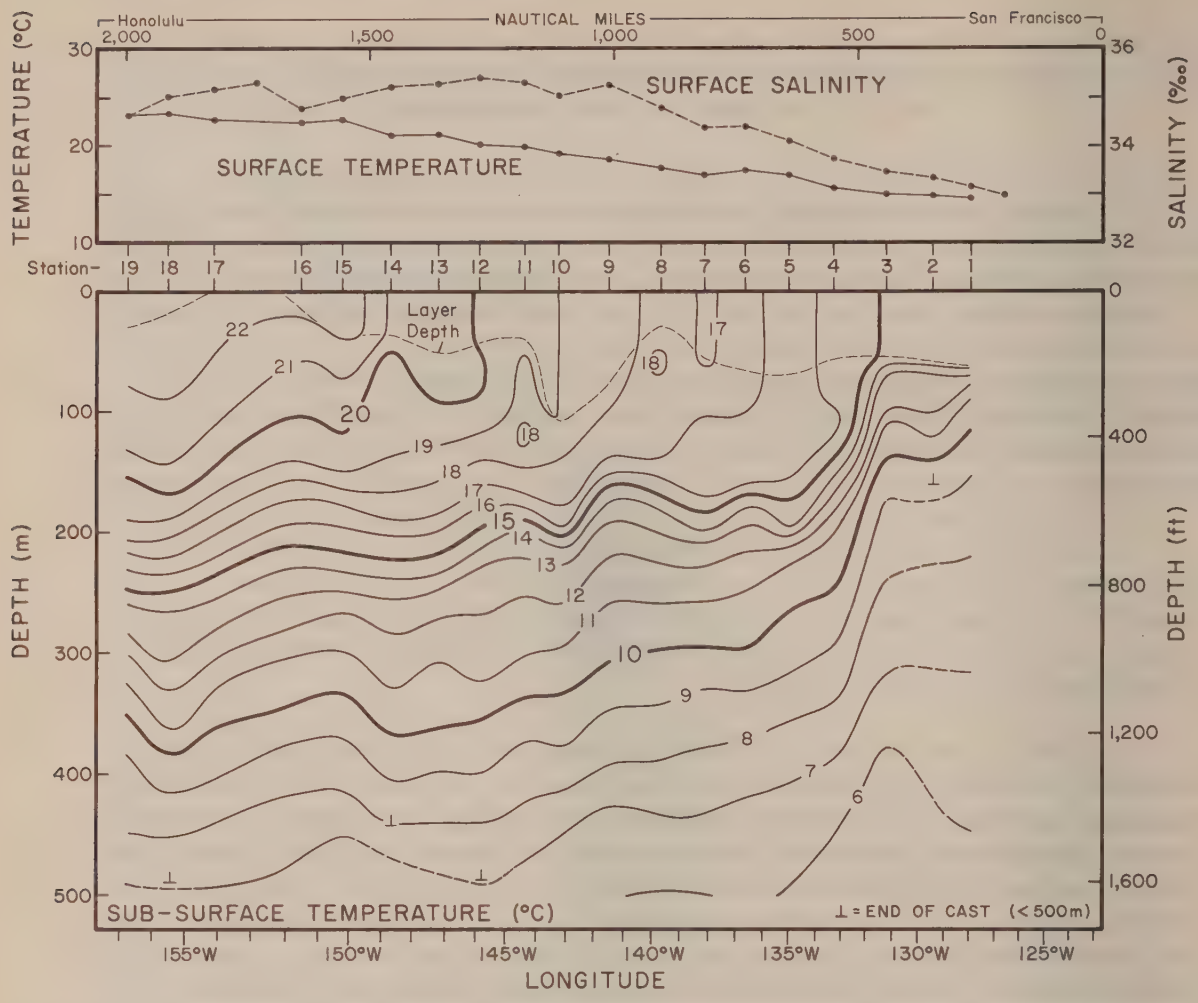
Stormy weather at the first of the month caused the ship to divert from its usual course out of San Francisco so that the track from 127° W to about 145° W is about 100 to 150 nautical miles south of the usual route, which was taken at mid-month. This affords the opportunity to gain some information on the geographical orientation of the transition zone.

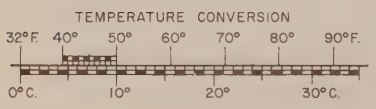
Along the usual track (Plate 6) the temperature conditions at mid-month show little change in the location of the water masses and position of the transition zone since mid-April. The temperature maximum about 100 m below the surface is about 600 nautical miles from the coast (at Station 6) and relatively close to the western edge of the California Current waters about 800 nautical miles out. There appears to be a filament of relatively strong flow with a southeast component across the section about 550 to 600 miles out, a counterflow around 700 miles out, and again a relatively strong southeastward flow about 800 miles out. The counterflow or eddy is associated mainly with the subsurface conditions at Stations 6 and 7 because the surface salinities of less than 33.5‰ are indicative of an overlying thin layer of the modified sub-arctic water in the California Current northeast of the main transition zone. The transition zone is narrow at the surface, lying between Stations 8 and 10, about 900 nautical miles from the coast. The Eastern North Pacific Central water is encountered at Station 10 almost 1000 miles from the coast and extends westward through the remainder of the section.

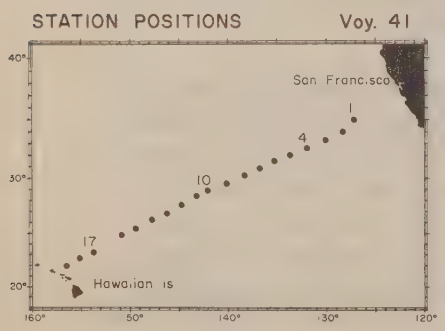
The temperature structure in Plate 5 shows that conditions are notably different 100 nautical miles farther south of the normal track between longitudes 130° and 140°W. There is no pronounced subsurface maximum, only one region of stronger flow occurs and that is between Stations 3 and 5 only 400 to 600 nautical miles from the coast. The transition zone is broad and diffuse at the surface, spanning more than 300 nautical miles of the track, Stations 5 through 8. The Eastern North Pacific Central Water is thus encountered on this track also about 1000 nautical miles from the coast.

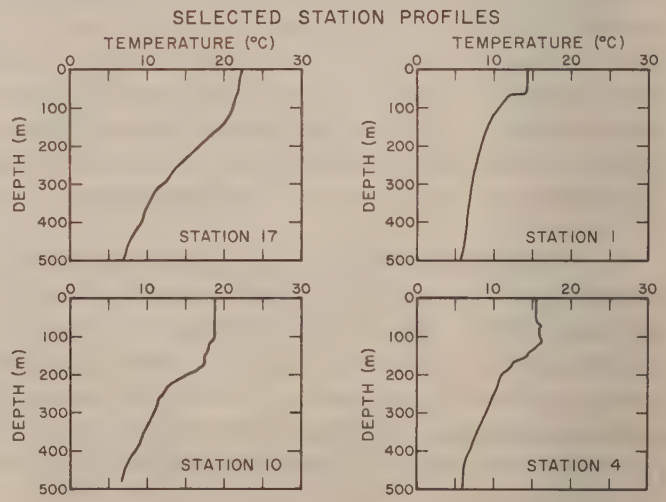
APRIL 30–MAY 3, 1972
SS HAWAIIAN ENTERPRISE, Voyage 41

PLATE 5.



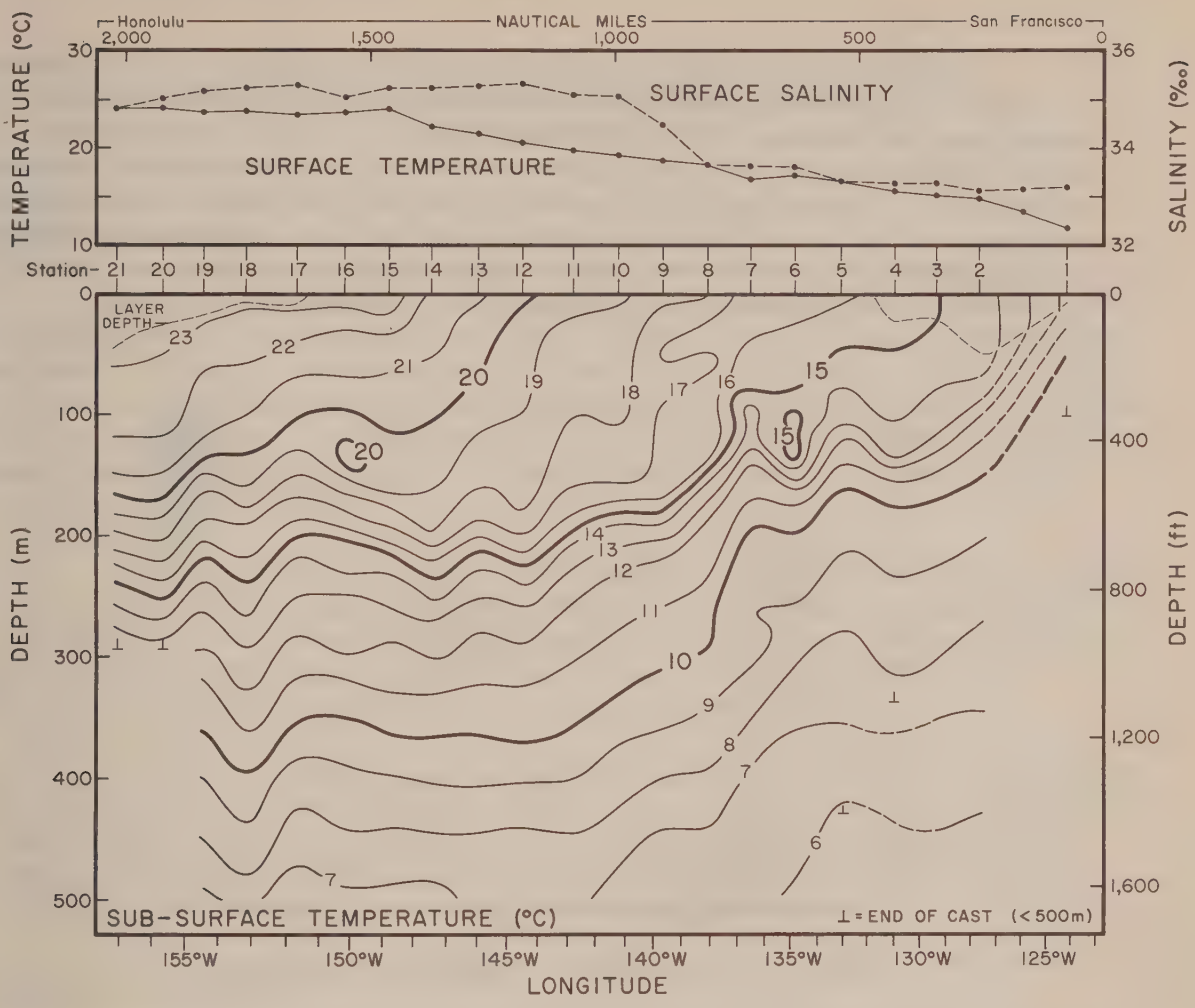


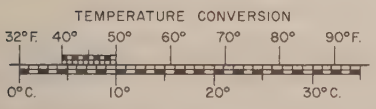




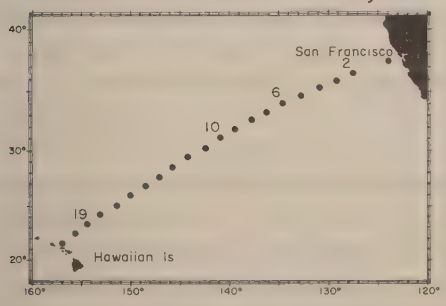
MAY 13-17, 1972
SS HAWAIIAN ENTERPRISE, Voyage 42

PLATE 6.

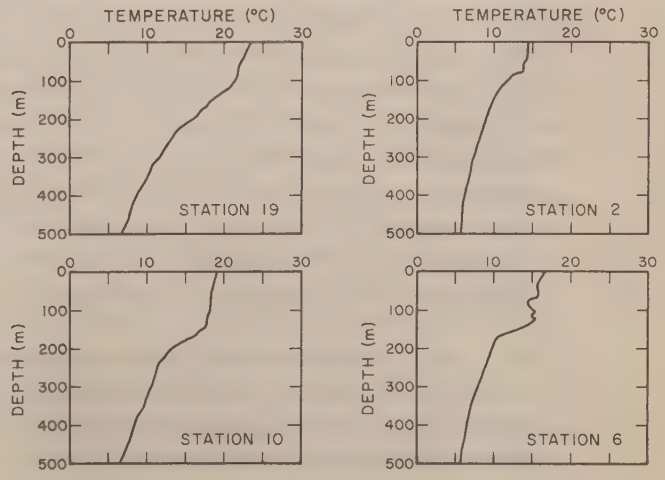




STATION POSITIONS Voy. 42



SELECTED STATION PROFILES



One possible interpretation of these characteristics is depicted schematically in Plate 7. The transition zone at the southwest edge of the modified sub-arctic waters feeding into the California Current lies west-northwest to east-southeast, and is narrow and sharp at 140° W longitude but becomes broader and more diffuse eastward around 135° W. The strongest flow appears on the inner (northeast) edge of the transition zone. At 135° to 140° W there is either a meander in the current or some type of eddy system to the north of the surface position of the transition zone. How typical this is or how it might affect albacore migration is not known at this time.

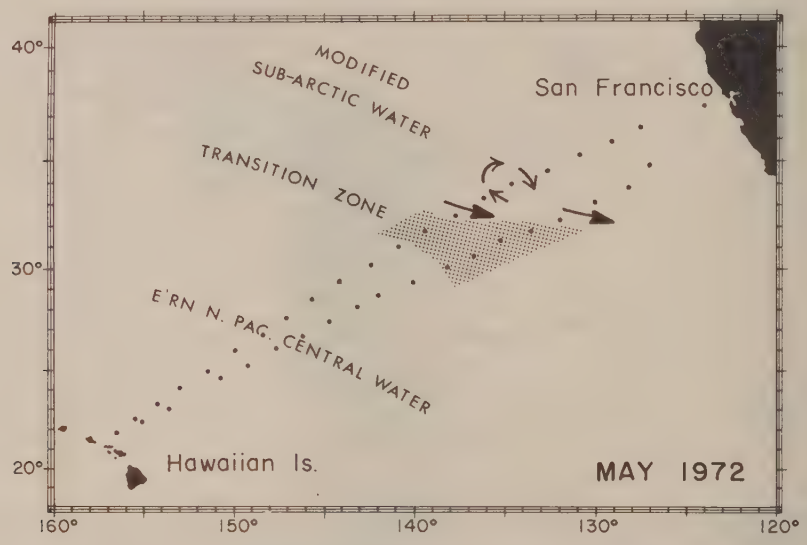


PLATE 7.– TRANSITION ZONE AND CURRENTS

The effect of wind conditions is notable in the difference of the surface layers in the two sections. With winds of 10 to 12 knots at the beginning of the month, the layer depths of around 50 to 70 m persisted from mid-April. At mid-month the winds were unusually light, being only 3 to 6 knots over most of the section except near California and near Hawaii. As a result, warming occurred in a thin surface layer and vertical temperature gradients existed in the upper 30 m at mid-month as opposed to well mixed layers earlier (see selected profiles in Plates 5 and 6). The upward trend of surface temperature anomalies in this region could thus be reduced or halted by stronger winds causing vertical mixing.

Due to instrument failures the XBT sections for May do not provide information on the upwelling and heat content of waters near the coast. In the California Current region from about 200 miles of the coast to about 700 nautical miles the heat content continues to rise seasonally and is now above that observed in 1967 and 1969 and approaching that observed in 1968. This is in agreement with the spread of the pool of warm water from the Eastern Central North Pacific toward the coast as described in the section on ocean temperature conditions.

NARRATIVE DESCRIPTION OF OCEAN TEMPERATURE CONDITIONS
MAY 1972

Northeastern Pacific

Seasonal warming of surface waters, which began in isolated areas in April, extended over the entire eastern North Pacific this month. The largest changes were northwest of Hawaii, between latitudes 20° and 30° N, where temperatures increased by as much as 6° F over values in the previous month. The above-normal heating in this region was due to a combination of 1) above-normal solar radiation heating the ocean surface because of low cloud cover, and 2) below-normal evaporative cooling resulting from light winds.

Although warming of surface waters did occur along most of the coast during the month, cooler-than-normal temperatures still prevailed in the region from the coast out to 140° W. The largest deviations below normal were offshore the Pacific Northwest and between latitudes 28° and 32° N, where above-normal cloud cover decreased warming of surface layers by solar radiation.

Low pressure systems in the Gulf of Alaska were deeper-than-normal and displaced to the west over the Aleutian Islands throughout most of the month. As a result, above-normal northwesterly winds inhibited seasonal warming of surface waters between 35° and 45° N and west of 145° W through increased evaporation and southeastward transport of cooler water from the north.

Eastern Tropical Pacific

Sea surface temperatures along a narrow strip of the coast of South America from the equator to 10°S are now near normal. The return to normal of sea surface temperature conditions in this region is related to the reestablishment of the subtropical high pressure center off South America, and to the development of the southeast trades at 10 to 15 knots off the coast. As a result a broader zone of upwelling can be expected to develop during the next two months. Farther off the coast from about 82°W to 90°W temperatures remained above normal in May.

Temperatures along the equator between 5°S to 5°N and from the coast of Ecuador to 115°W have also remained above normal because of the weak southeast trades along the equator. As a result, there has been a delay in the westward extension of the Peru Current and the usual equatorial cooling associated with extensive upwelling.

Temperatures over most of the tropical Pacific from the equator to 20°N remained slightly above normal because of lower wind speeds and less cloud cover than normal. The intertropical convergence zone (ITCZ) was near the normal position for May. Several chubascos formed along the ITCZ near 10°N between 85°W and 100°W and also between 125°W and 140°W. Extensive cloudiness and wind mixing kept surface temperatures below normal in these areas.

SEA SURFACE TEMPERATURE CHARTS, PACIFIC OCEAN
MAY 1972

Acknowledgements

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Living Marine Resources Inc., San Diego, California
National Oceanic and Atmospheric Administration
National Marine Fisheries Service, La Jolla, California; Honolulu, Hawaii; Seattle, Washington
National Weather Service, San Diego, California
National Ocean Survey, Pacific Marine Center, Seattle, Washington
Pacific Environment Institute, Fisheries Research Board of Canada West Vancouver, British Columbia, by H. J. Hollister from observations by S. G. Westhaver at Langara Island Light; J. Godin at Cape St. James Light; L. Collins at Kains Island Lightstation; O. A. Edwards at Amphitrite Point Light
Scripps Institution of Oceanography, La Jolla, California, by Margaret Robinson
U.S. Naval Weather Service, Fleet Numerical Weather Central, Monterey, California
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The cooperation of Matson Navigation Company and assistance of the Mates of the S.S. Hawaiian Enterprise in obtaining the expendable bathythermograph observations for the vertical temperature sections is acknowledged.

Charts

Figure 1.--Twelve-year mean (1961-1972) observed sea level values of barometric pressure (millibars), resultant wind direction (degrees true), resultant wind speed (knots) and average wind speed (knots) regardless of direction.

Figure 2.--Observed sea level values of barometric pressure (millibars), resultant wind direction (degrees true), resultant wind speed (knots), and average wind speed (knots) regardless of direction.

Figure 3.--Mean sea surface temperature, eastern North Pacific Ocean. Squares show temperatures at weather ship stations. Numerals on shore are temperatures at coastal and lightship stations.

Figure 4.--Mean sea surface temperature chart, western North Pacific Ocean.

Figure 5.--Deviation of sea surface temperatures, eastern North Pacific Ocean from long-term charts of H. O. 225. Hatched areas are colder in 1972.

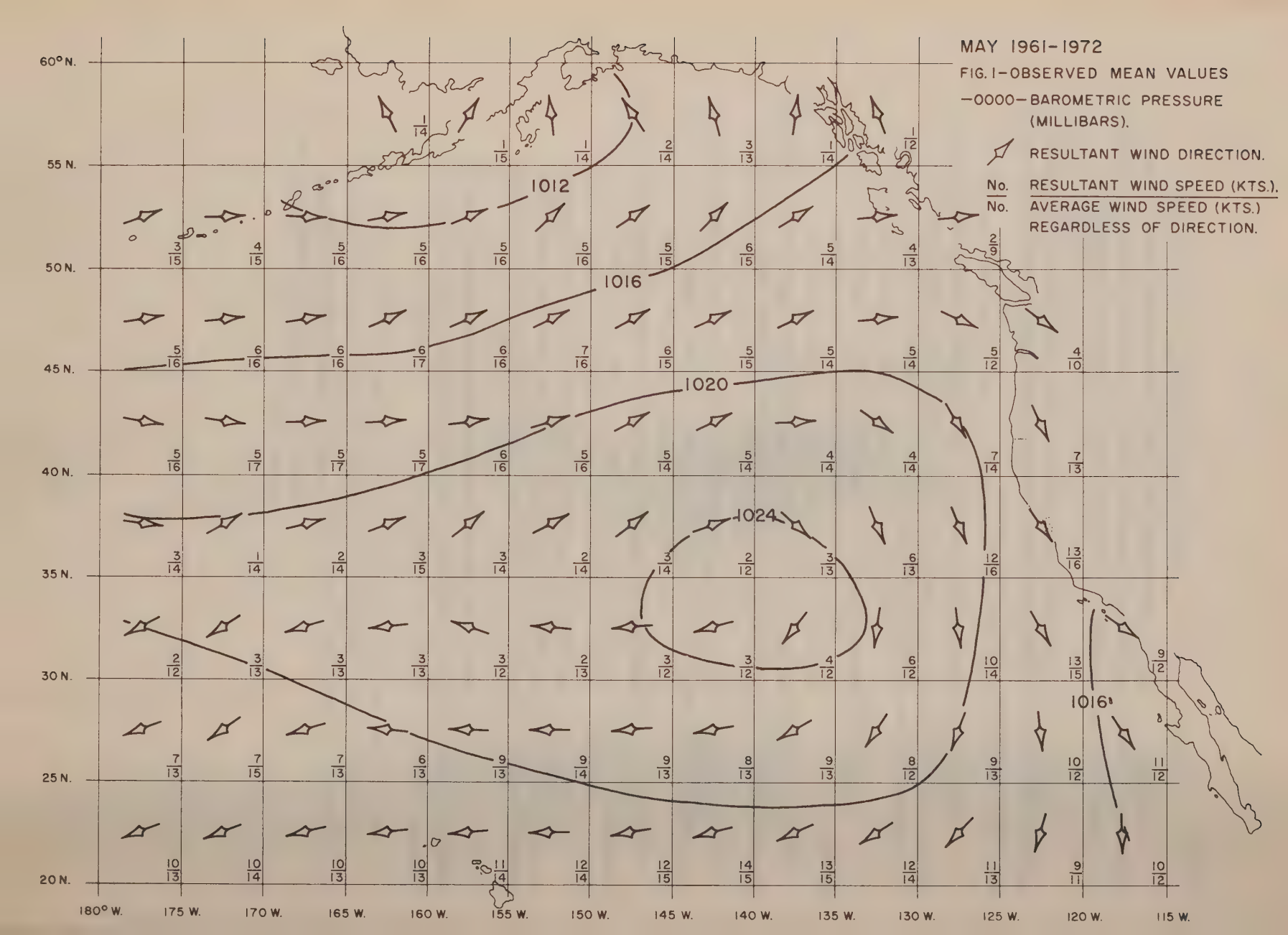
Figure 6.--Deviation of sea surface temperatures, eastern North Pacific Ocean from those of May 1971. Hatched areas are colder in 1972.

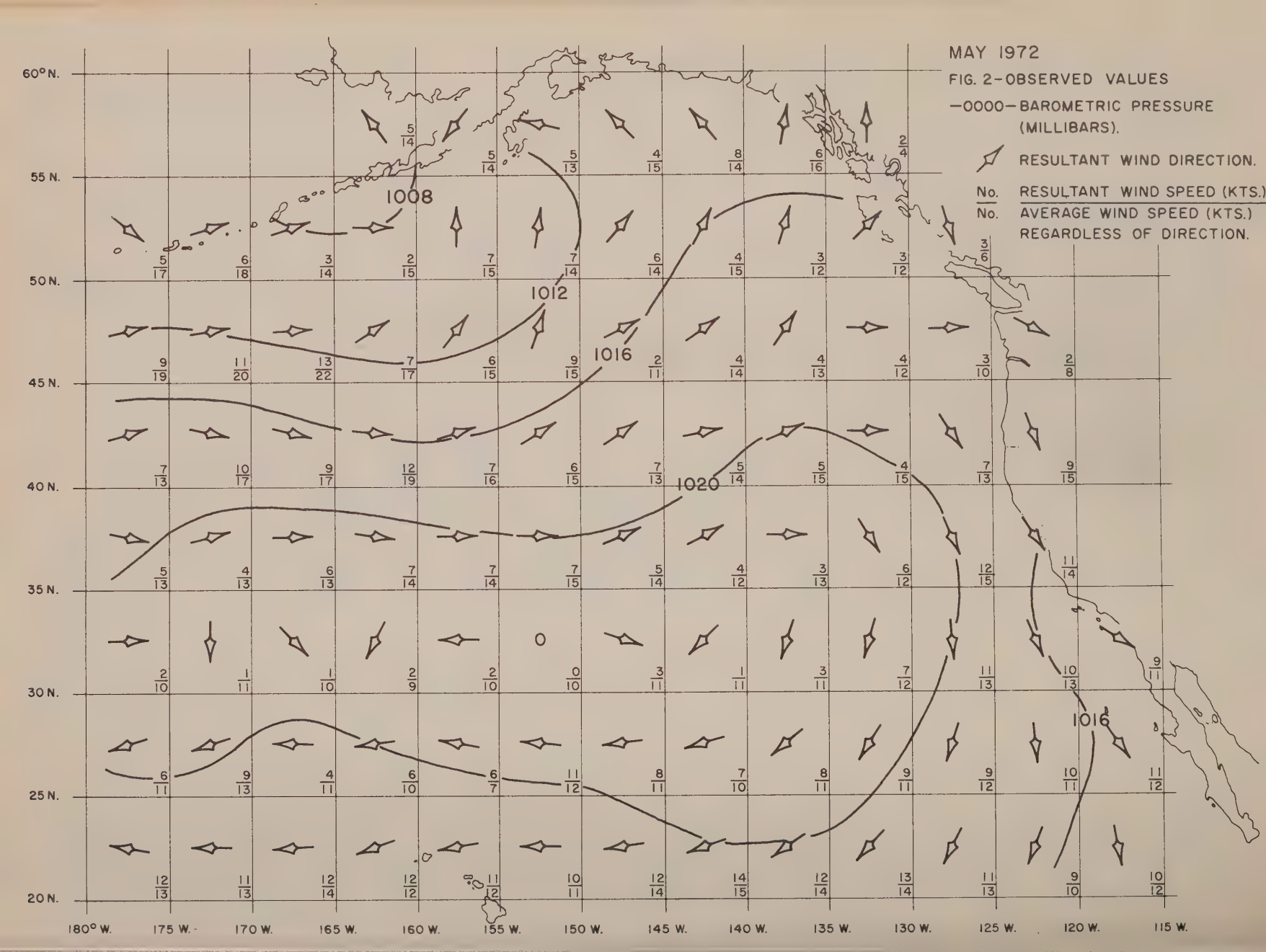
Figure 7.--Mean sea surface temperature, eastern tropical Pacific Ocean. Numerals on shore are temperatures at coastal stations.

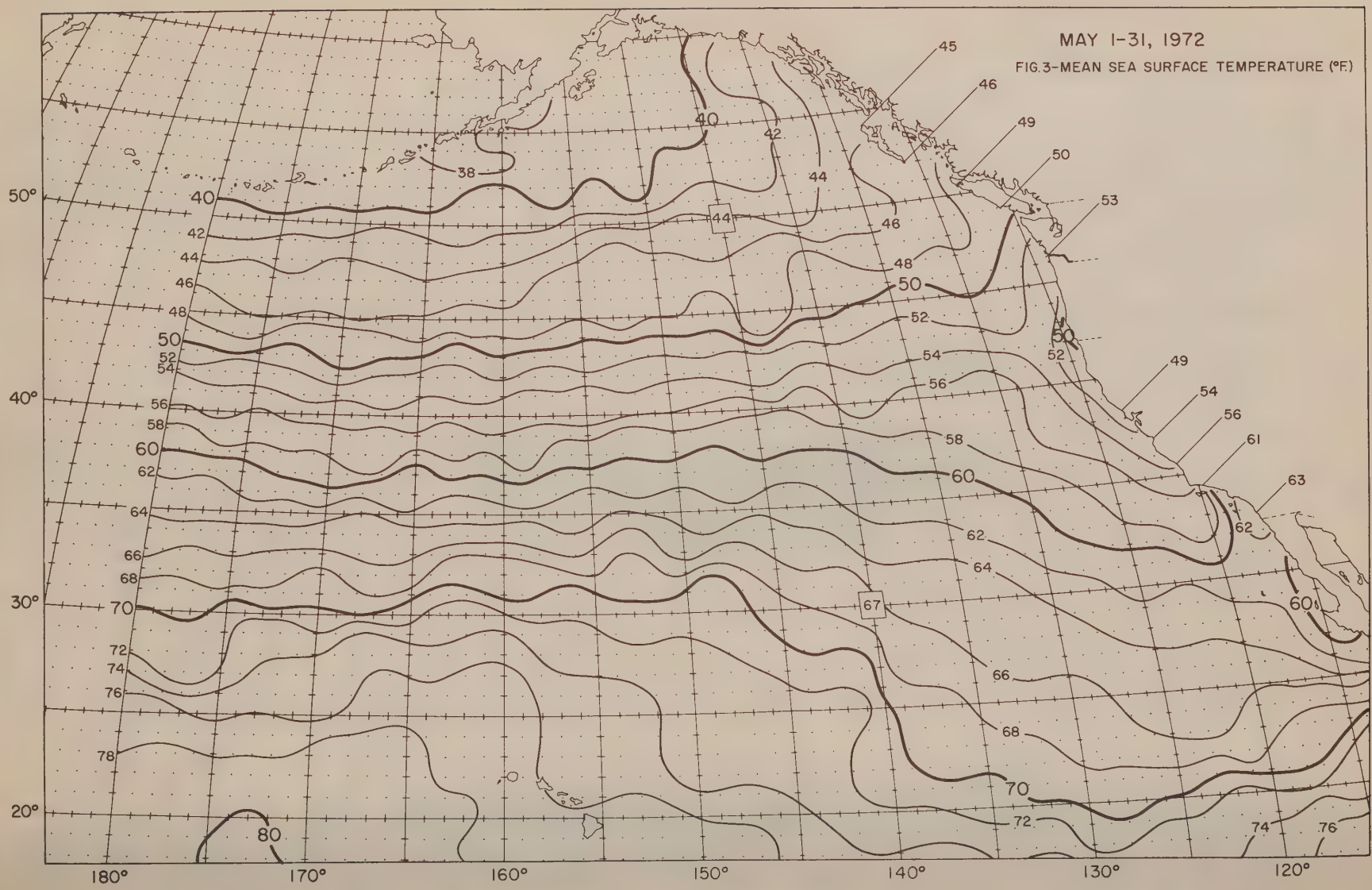
Figure 8.--Deviation of sea surface temperatures, eastern tropical Pacific Ocean from long-term charts of H. O. 225 and NAVOCEANO sp-123. Shaded areas are colder in 1972. Contours are dashed in sparse data areas.

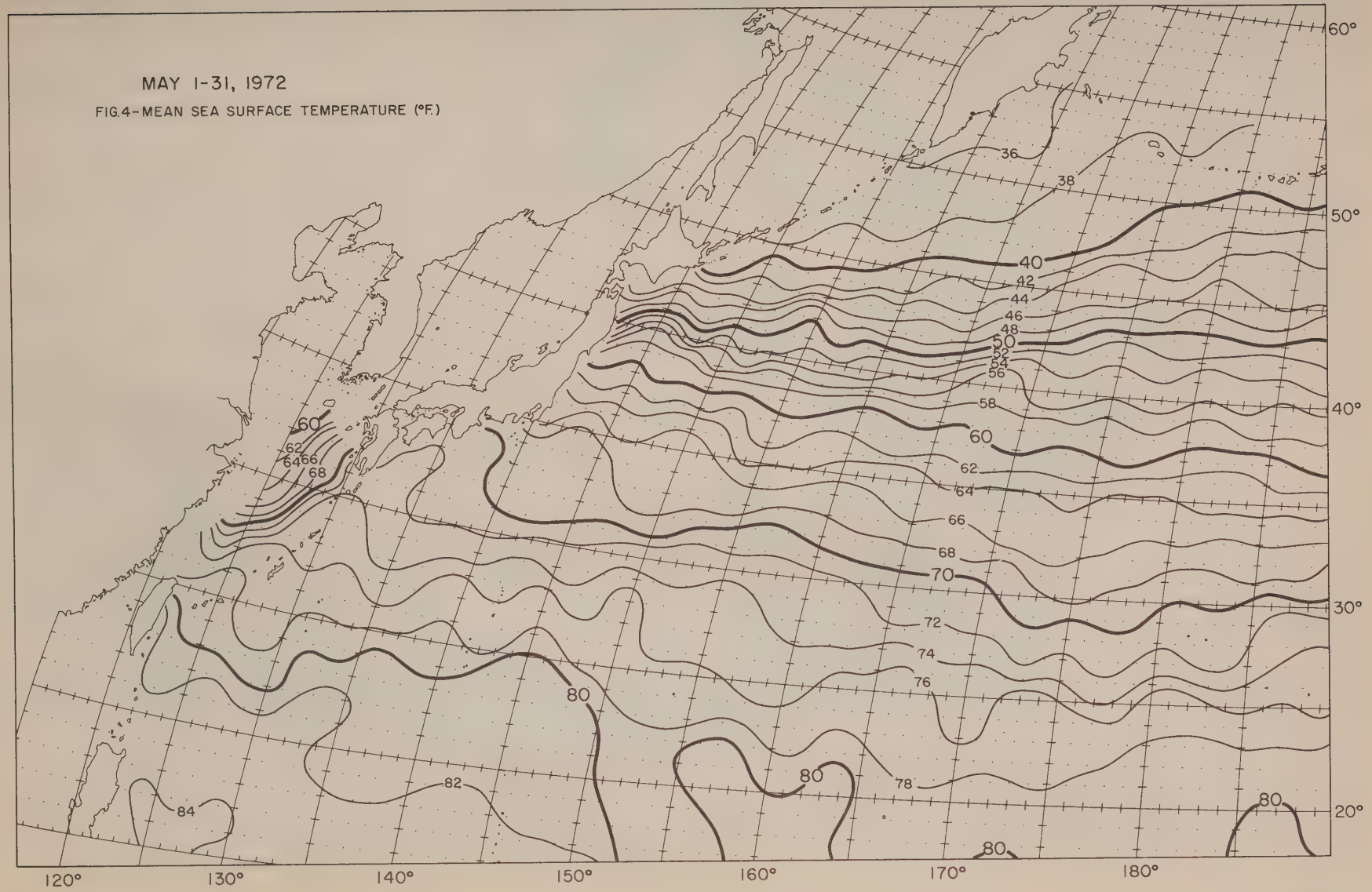
Figure 9.--Deviation of sea surface temperatures, eastern tropical Pacific Ocean from those of May 1971. Shaded areas are colder in 1972. Contours are dashed in sparse data areas.

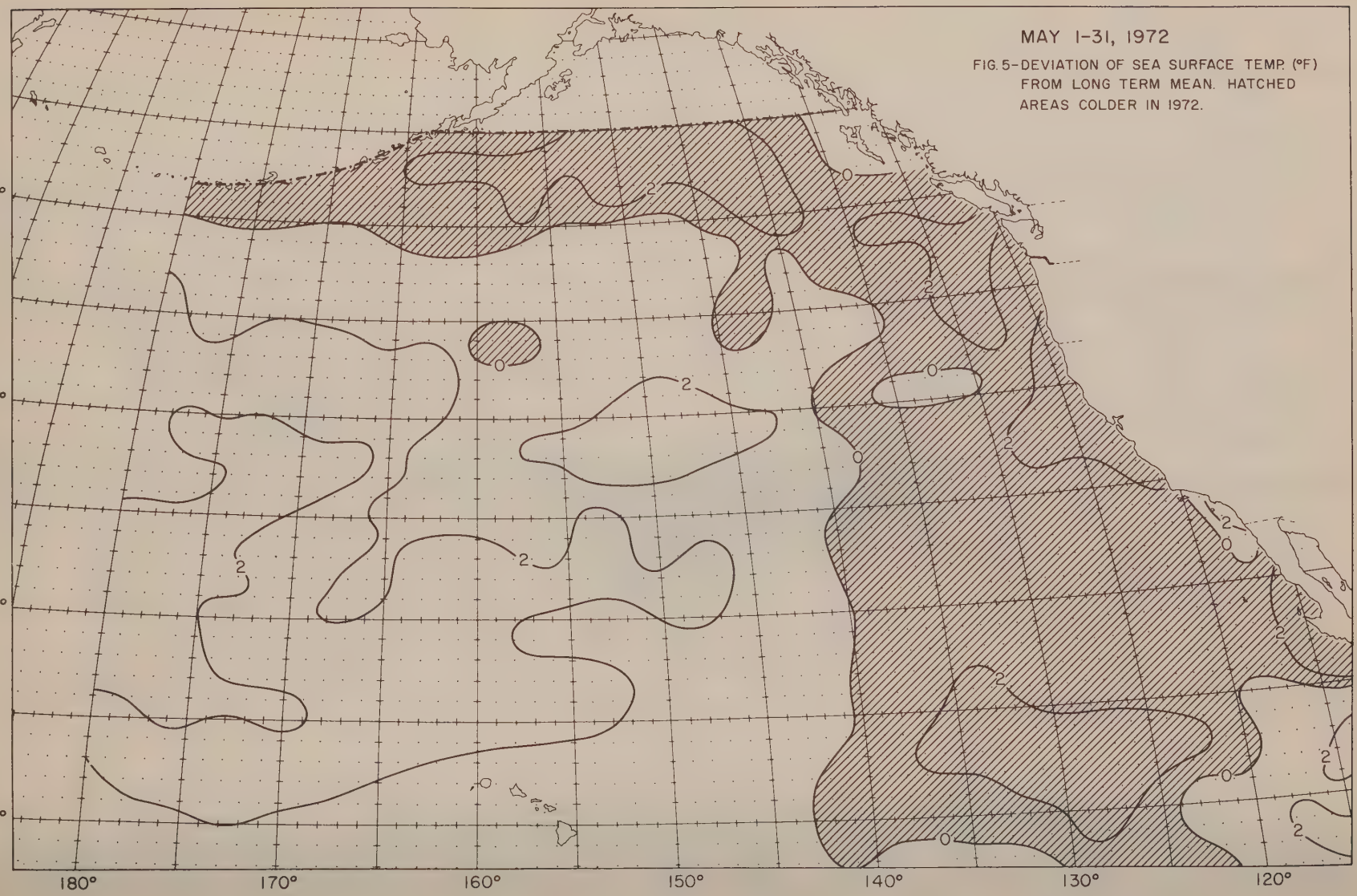
James A. Renner, Fishery Biologist
Kenneth S. Raymond, Scientific Illustrator
June 9, 1972

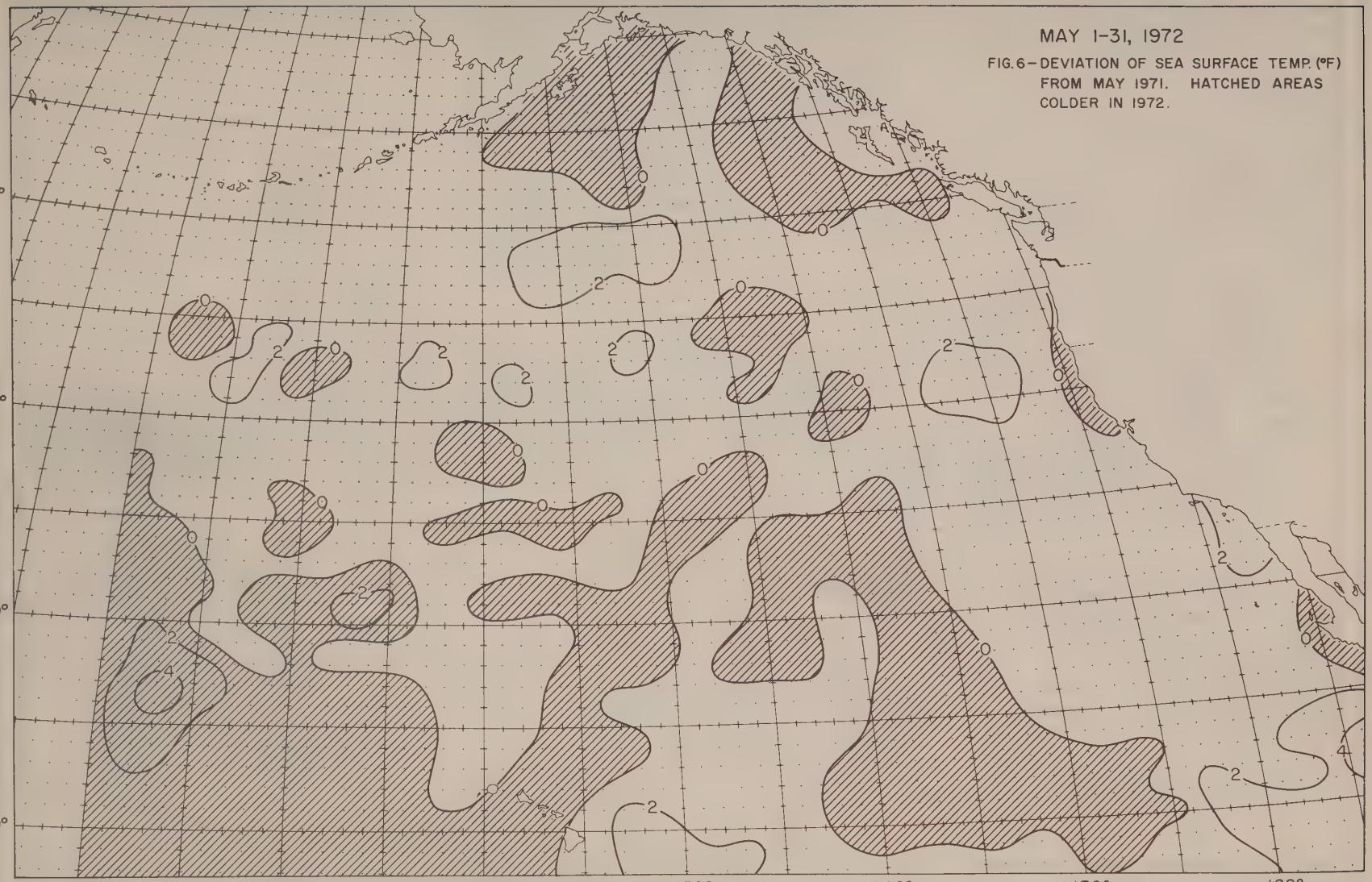

MAY 1961-1972
FIG. 1-OBSERVED MEAN VALUES
—0000— BAROMETRIC PRESSURE (MILLIBARS).
RESULTANT WIND DIRECTION.
No. RESULTANT WIND SPEED (KTS.).
No. AVERAGE WIND SPEED (KTS.) REGARDLESS OF DIRECTION.
1012
1016
1020
1024
1016
60° N.
55 N.
50 N.
45 N.
40 N.
35 N.
30 N.
25 N.
20 N.
180° W.
175 W.
170 W.
165 W.
160 W.
155 W.
150 W.
145 W.
140 W.
135 W.
130 W.
125 W.
120 W.
115 W.

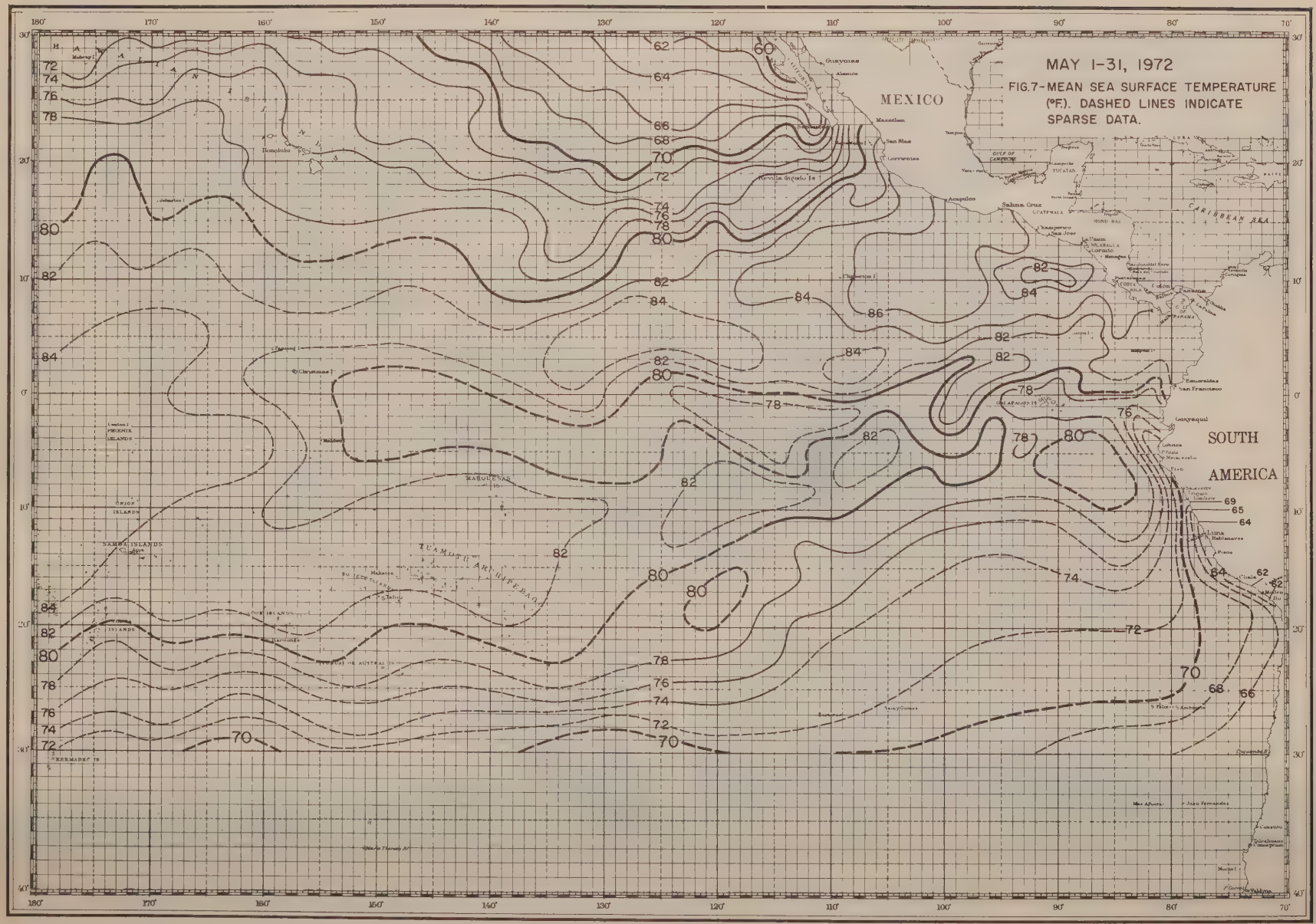

MAY 1972
FIG. 2-OBSERVED VALUES
—0000— BAROMETRIC PRESSURE (MILLIBARS).
RESULTANT WIND DIRECTION.
No. RESULTANT WIND SPEED (KTS.).
No. AVERAGE WIND SPEED (KTS.) REGARDLESS OF DIRECTION.
1008
1012
1016
1020
1016
60° N.
55 N.
50 N.
45 N.
40 N.
35 N.
30 N.
25 N.
20 N.
180° W.
175 W.
170 W.
165 W.
160 W.
155 W.
150 W.
145 W.
140 W.
135 W.
130 W.
125 W.
120 W.
115 W.

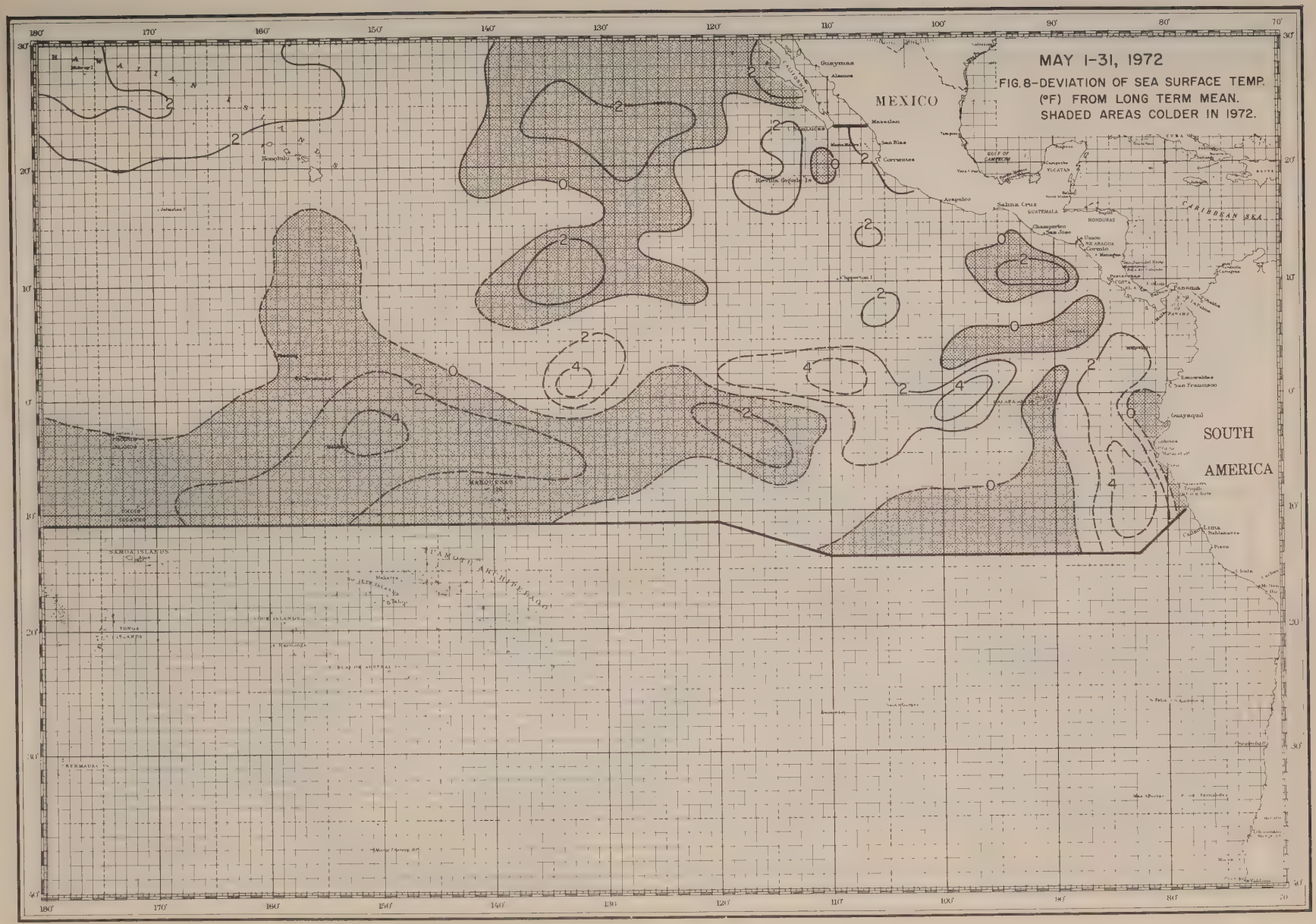

MAY 1-31, 1972
FIG.3-MEAN SEA SURFACE TEMPERATURE (°F.)
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°

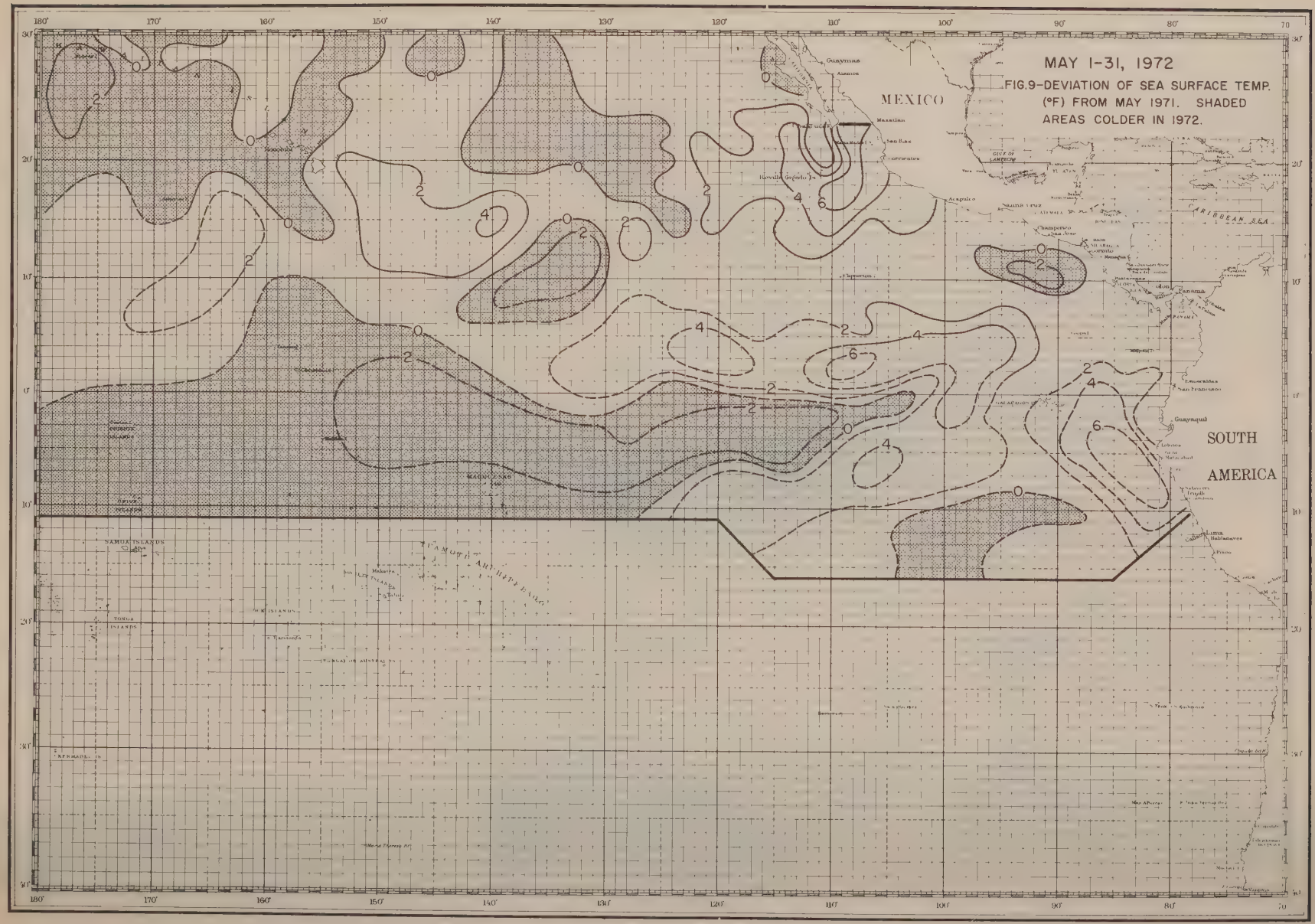

MAY 1-31, 1972
FIG.4-MEAN SEA SURFACE TEMPERATURE (°F.)
60°
50°
40°
30°
20°
120°
130°
140°
150°
160°
170°
180°
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80
82
84


MAY 1-31, 1972
FIG. 5-DEVIATION OF SEA SURFACE TEMP. (°F) FROM LONG TERM MEAN. HATCHED AREAS COLDER IN 1972.
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°
0
2

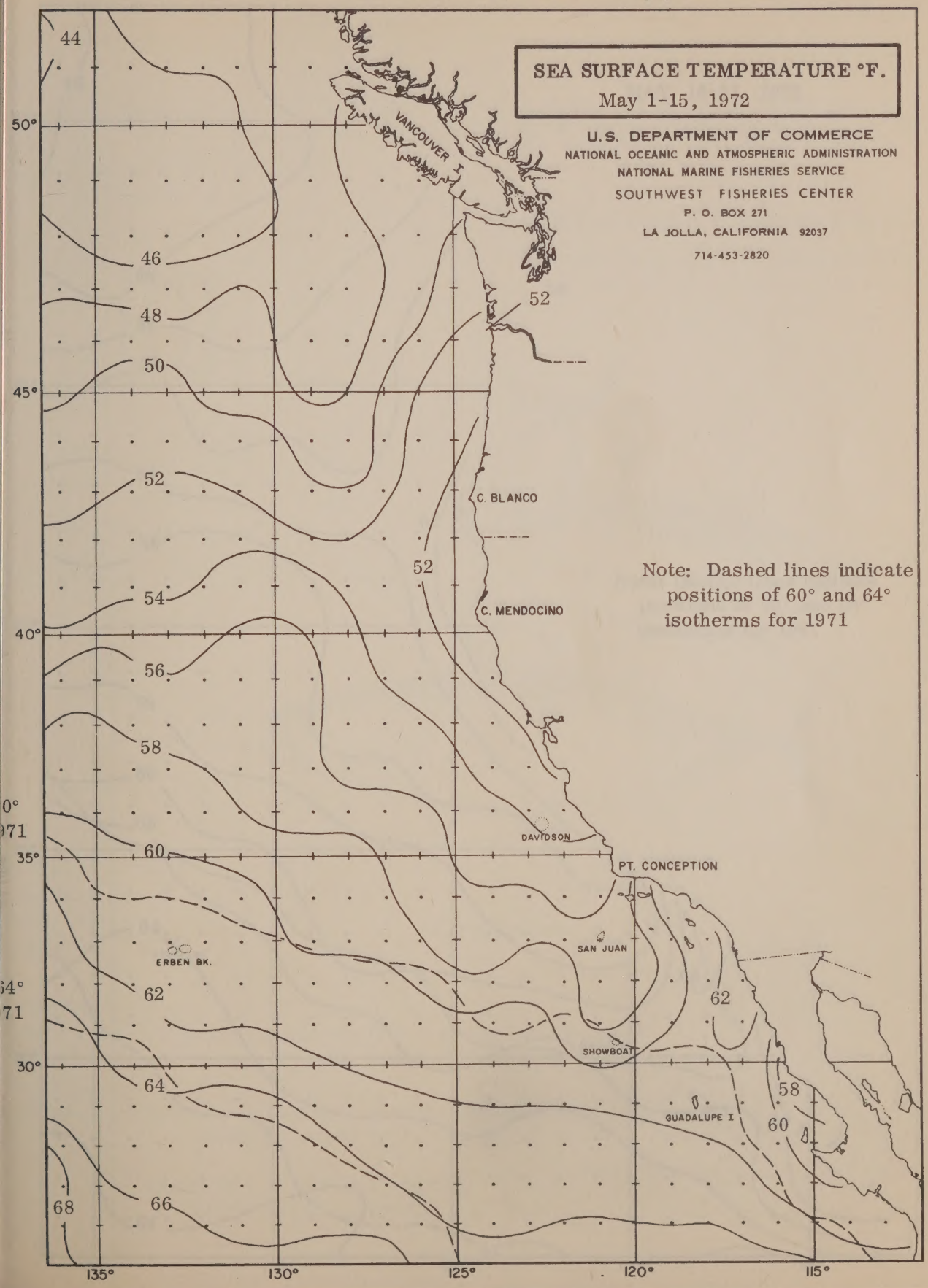

MAY 1-31, 1972
FIG. 6 – DEVIATION OF SEA SURFACE TEMP. (°F) FROM MAY 1971. HATCHED AREAS COLDER IN 1972.
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°

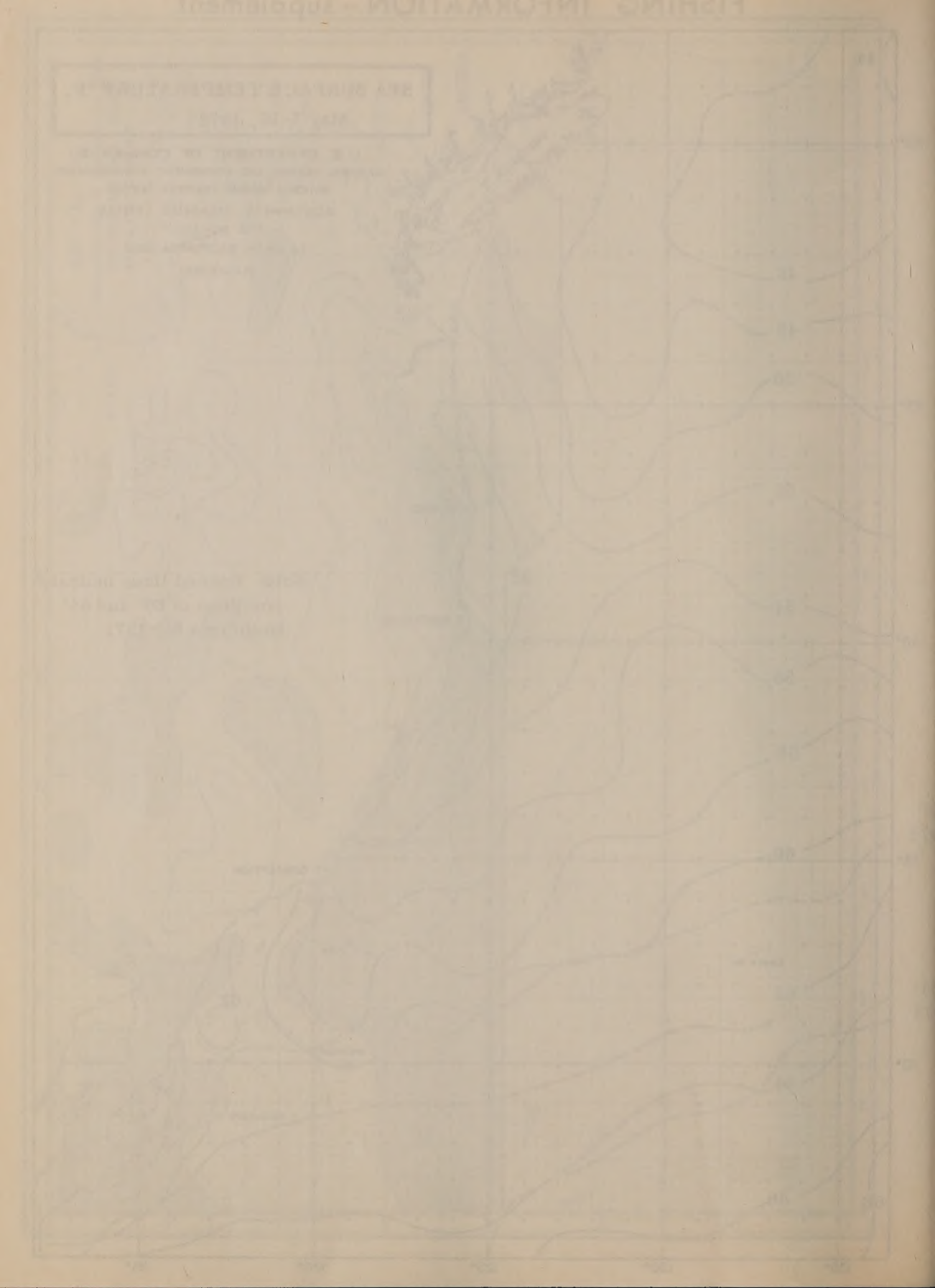

MAY 1-31, 1972
FIG.7-MEAN SEA SURFACE TEMPERATURE (°F). DASHED LINES INDICATE SPARSE DATA.
MEXICO
SOUTH AMERICA
CARIBBEAN SEA
GULF OF CAMPECHE
YUCATAN
Acapulco
Salina Cruz
Guayaquil
Panama
Honolulu
Lima
Callao
60
62
64
66
68
70
72
74
76
78
80
82
84
86
69
65

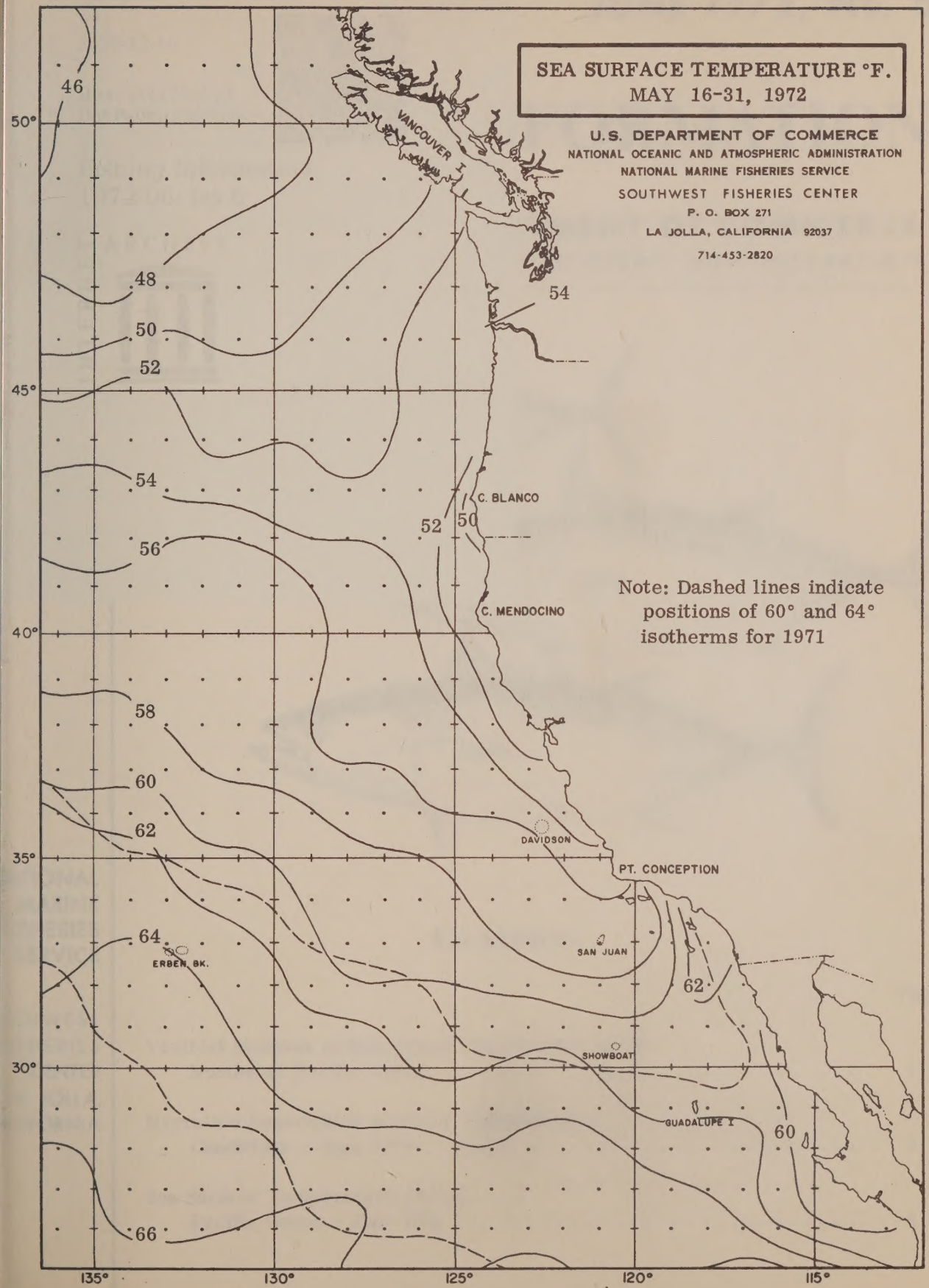

MAY 1-31, 1972
FIG. 8-DEVIATION OF SEA SURFACE TEMP. (°F) FROM LONG TERM MEAN.
SHADED AREAS COLDER IN 1972.
MEXICO
SOUTH AMERICA
CARIBBEAN SEA
GUATEMALA
HONDURAS
COSTA RICA
PANAMA
GULF OF CALIFORNIA
Guaymas
Mazatlan
San Blas
Corrientes
Acapulco
Salina Cruz
Champerico
Puntarenas
Panama
Esmeraldas
Guayaquil
Lima
Pisco
Callao
Paita
Talara
Honolulu
Jaluit
Marshall Islands
Makin
Tabiteuea
Tarawa
Ocean Island
Nauru
Phoenix Islands
Tokelau Islands
Tonga Islands
Samoa Islands
Kermadec Islands
Rapa
Tuamotu Archipelago
Marquesas Islands
Galapagos Islands
Clipperton I.
Revilla Gigedo Is.
Tehuantepec
Fonseca
Nicaragua
Chiriqui
Darien
Gulf of Panama
Gulf of Guayaquil
Gulf of Fonseca
Gulf of Tehuantepec
Gulf of Nicoya
Gulf of Darien
Gulf of Chiriqui


MAY 1-31, 1972
FIG.9-DEVIATION OF SEA SURFACE TEMP. (°F) FROM MAY 1971. SHADED AREAS COLDER IN 1972.
MEXICO
CARIBBEAN SEA
SOUTH AMERICA
SAMOA ISLANDS
TONGA ISLANDS
180°
170°
160°
150°
140°
130°
120°
110°
100°
90°
80°
70°
30°
20°
10°
0°
10°
20°
30°

FISHING INFORMATION - supplement






SEA SURFACE TEMPERATURE °F.
MAY 16-31, 1972
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES CENTER
P. O. BOX 271
LA JOLLA, CALIFORNIA 92037
714-453-2820
Note: Dashed lines indicate positions of 60° and 64° isotherms for 1971
VANCOUVER
C. BLANCO
C. MENDOCINO
DAVIDSON
PT. CONCEPTION
SAN JUAN
SHOWBOAT
GUADALUPE I.
ERBEN BK.
46
48
50
52
54
56
58
60
62
64
66
50°
45°
40°
35°
30°
135°
130°
125°
120°
115°